at Miami, Saline Co., Oct. 11, 1936, *Steyermark 20435;* upper wooded top of limestone bluffs at east end of Hickory Ridge, 1 mi. west of Delta, Cape Girardeau Co., Nov. 8, 1936, *Steyermark 20788.*

Field Museum of Natural History,
Chicago, Illinois

THE OSCILLATORIACEAE OF SOUTHERN MASSACHUSETTS

Francis Drouet

(*Continued from page 241*)

PHORMIDIUM Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16**: 156 (1892).—The diffluence of sheaths in this genus is a character often of too qualitative a nature for the beginner to recognize at first sight. It is evidenced macroscopically, however, in the tenacious character of the plant masses; whereas species of Oscillatoria form plant masses which are so fragile that they do not retain the original shape when lifted from the habitat, it is only rarely that the plant mass of a species of Phormidium breaks or loses form when lifted from its habitat. Microscopically the presence of amorphous jelly can be demonstrated easily by staining with dilute aqueous solutions of various dyes. A number of widely distributed species of this genus in North America are omitted here because of lack of specimens from southern Massachusetts. Among these are *P. purpurascens* (Kütz.) Gom., *P. laminosum* (Ag.) Gom., *P. Treleasei* Gom., *P. inundatum* Kütz. ex Gom., *P. Setchellianum* Gom., *P. favosum* (Bory) Gom., *P. subfuscum* (Ag.) Kütz. ex Gom., *P. uncinatum* (Ag.) Gom., and *P. penicillatum* Gom. *P. favosum* as distributed in Phyc. Bor.-Amer. 1652 is treated here as *P. autumnale.*

Key to Species

I. Trichomes torulose, apices not calyptrate
  A. Trichomes narrow (less than 4 μ in diameter)
    1. Plant-mass growing within the sheaths of other algae or small animals.—Stratum small, pale or yellowish blue-green, in fresh water; filaments short (to 50 μ long), straight, often parallel; sheaths usually entirely diffluent or thin and hyaline, not coloring blue when treated with chlor-zinc-iodine; trichomes pale blue-green, 1.3–2 μ in diameter; cells as long as or twice as long as wide; protoplasm finely granulose; apical cell rotund above, rarely obtuse-conical. . . . . *P. mucicola*
    2. Plant-mass not within the sheaths of other algae or animals
      a. Plants of salt or brackish water, rarely in fresh water; trichomes very small (less than 2.5 μ in diameter)
        (I) Stratum thin, rose-colored, in salt water; filaments loosely intertwined; sheaths thin or entirely diffluent into an amorphous mucus,

not coloring blue when treated with chlor-zinc-iodine; trichomes pale rose-colored, attenuate at the apices, 1.7–2 μ in diameter; cells 2–7 μ long; rarely quadrate; protoplasm homogeneous; apical cell acute-conical..... *P. persicinum*

(II) Stratum mucous, lamellose, yellowish or brownish-green, in brackish or hot water; sheaths hyaline, diffluent into an apparently fibrous mucus, not coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, variously interwoven or parallel, attenuated at the apices, 1.2–2.3 μ in diameter; cells subquadrate, 1.2–3 μ long; protoplasm not granulose; apical cell acute-conical..... *P. fragile*

b. Plants of fresh water; trichomes larger (2.5–4 μ in diameter).—Stratum thin-laminose, mucous, bright blue-green; sheaths diffluent into an amorphous mucus, not coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, straight or almost so, parallel or variously intricated, not attenuate at the apices, 2.7–3.3 μ in diameter; cells cylindrical or barrel-shaped, quadrate or twice as long as wide, 3–7.8 μ long; protoplasm coarsely granulose; apical cell rotund..... *P. molle*

B. Trichomes broad (more than 4 μ in diameter).—Plant-mass penicillate, attached by a basal stratum in fresh water, the free portion elongate, gelatinous, dark blue-green, yellowish-violet when dried; filaments more or less straight, parallel, closely agglutinated; sheaths often evident, mucous and usually entirely diffluent, not coloring blue when treated with chlor-zinc-iodine; trichomes pale blue-green (yellowish-violet when dried), straight and often long-attenuate at the apices, 6–8.5 μ in diameter; cells quadrate or longer than wide (rarely to half as long as wide), 3–11 μ long; protoplasm finely granulose; cross-walls never granulated; apical cell more or less acute-conical or cylindric-conical..... *P. tinctorium*

II. Trichomes not constricted at the cross-walls, at least not torulose except in certain species in which calyptras are present

A. Trichomes not conspicuously calyptrate; apical cell never enlarged and capitate

1. Plant-mass violet, in fresh water; sheath material not coloring blue when treated with chlor-zinc-iodine.—Stratum membranaceous, lamellose, blue-violet or blackish-violet above, gray-green beneath; filaments straight, parallel or intermeshed; sheaths at first thin, scarcely evident, later entirely diffluent into an amorphous jelly; trichomes straight and not attenuate, fragile, very slightly constricted at the cross-walls, 1.7–2 μ in diameter; cells subquadrate or longer than wide, 1.8–4.7 μ long; protoplasm not granulose; cross-walls not granulated; apical cell rotund, without calyptra..... *P. luridum*

2. Plant-mass not violet

a. Trichomes narrow (usually less than 4.5 μ in diameter)

(I) Stratum bright blue-green, membranaceous, expanded; filaments elongate, more or less straight, closely intermeshed; sheaths thin, diffluent into an apparently fibrous mucus, coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, not at all or very slightly constricted at the cross-walls, often indistinctly articulated, at first straight then uncinate and attenuate at the apices, 1–2 μ in diameter; cells 2.5–5 μ long; protoplasm homogeneous; apical cell often acute-conical, without calyptra.....*P. tenue*

(II) Stratum lubricous, expanded, lamellose, up to 3 cm. thick, dirty green above, colorless beneath; filaments flexuous, closely interwoven; sheaths well defined and papery, later diffluent into a tenacious mucus, coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, straight at the apices, not attenuated, never constricted at the cross-walls, 2–2.5 μ in diameter; cells longer than wide, 3.3–6.7 μ long; protoplasm finely granular, the cross-walls marked with two or four granules; apical cell rotund, without calyptra.....*P. valderianum*

(III) Stratum blackish or brownish-green, expanded, membranaceous, coriaceous; filaments elongated, more or less flexuous, closely interwoven; sheaths thin, distinct, or diffluent into an amorphous mucus coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, not constricted at the cross-walls, briefly attenuated, 3–4.5 μ in diameter; cells subquadrate to twice as long as wide, 3.4–8 μ long; protoplasm seldom granulose; cross-walls usually conspicuous, not granulated; apical cell acute-conical, without calyptra.....*P. Corium*

(IV) Stratum blackish-green or blue-green, expanded, shining, thin but tough, fragile when dried, in fresh or somewhat brackish water; filaments elongate, rather flexuous, very closely interwoven; sheaths thin and papery or entirely diffluent, coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, slightly or not at all constricted at the cross-walls, straight and briefly attenuate at the apices, 3–5 μ in diameter; cells subquadrate or shorter than wide, 2–5 μ long; protoplasm often granulose; cross-walls conspicuous, never granulated; apical cell obtuse-conical, without calyptra. *P. papyraceum*

b. Trichomes broad (seldom found less than 4.5 μ in diameter)

(I) Plant mass bright blue-green or bluish-black, thick, compact, or rarely fasciculate-penicillate and attached at the base, in fresh water; filaments more or less straight, fragile; sheaths thin, usually more or less diffluent

into an amorphous mucus, not coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, not constricted at the cross-walls, or only so at the apices, rarely here and there almost torulose, straight and briefly attenuate at the apices, 4.5–12 μ in diameter; cells longer or shorter than wide, 4–8 μ long; protoplasm coarsely granulose; cross-walls conspicuous, usually ungranulated; apical cell briefly and scarcely attenuate, truncate, with a slightly thickened outer membrane ..... *P. Retzii*

(II) Stratum expanded, bright blue-green, yellowish-green, or blackish, in fresh (and slightly brackish) water; filaments elongated, flexuous, variously interwoven; sheaths firm or mucous and diffluent, in some collections thick and lamellose, coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, slightly constricted at the cross-walls, straight and not attenuate at the apices, 4–6 (–7) μ in diameter; cells 1.5–2.7 μ long; protoplasm usually rather coarsely granulose; cross-walls rarely granulated; apical cell rotund, its outer wall somewhat thickened ..... *P. ambiguum*

B. Trichomes conspicuously calyptrate; apical cell in some species enlarged and capitate

1. Cells of most trichomes of the plant-mass quadrate and shorter than wide.—Stratum expanded, fragile, dark blue-green, often yellowish-brown, subaerial or aerial in freshwater or secondarily brackish habitats; filaments straight, fragile, parallel, or variously intertwined; sheaths well defined, mucous, or diffluent into an amorphous jelly, never coloring blue when treated with chlor-zinc-iodine; trichomes blue-green or olive-green, never constricted at the cross-walls, capitate, briefly attenuate and scarcely curved or straight at tha apices, 4–7 μ in diameter; cells 2–5 μ long; protoplasm granulose; cross-walls frequently granulated; apical cell enlarged, bearing a more or less rotund calyptra ..... *P. autumnale*

2. Cells of most trichomes of the plant-mass quadrate or longer than wide.—Stratum membranaceous, coriaceous, dark green or bright blue-green, in salt water; filaments straight or variously contorted, often parallel or intermeshed; sheaths thin, often distinct and imbedded in an amorphous mucus, or as often wholly diffluent, not coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green (rarely lead-colored in dried material), constricted at the cross-walls, often distinctly torulose, straight and perceptibly long-attenuate at the apices, often almost capitate, 2.7–5.5 μ in diameter; cells subquadrate to twice as long as wide, 3–10 μ long; protoplasm finely granulose; cell-walls never granulated; apical cell obtuse-conical, bearing a depressed-conical calyptra ..... *P. submembranaceum*

PHORMIDIUM MUCICOLA Naum. & Huber in Huber-Pestalozzi & Naumann, Ber. d. d. bot. Ges. **47**: 68, f. 1–6 (1929).—Thus far observed in southern Massachusetts only in the sheaths of *Microcystis aeruginosa* Kütz. Dr. G. Huber-Pestalozzi has obligingly compared a duplicate of the second collection cited below with the original material of this species, which besides having been found at several stations in Europe has been reported by Rich from Kenya Colony in Journ. Linn. Soc. Zool. **38**: 271 (1933). I shall treat specimens from Argentina in another publication. The trichomes in our material are pale blue-green and often give one reason to suspect that they are rod-shaped bacteria, though masses of trichomes in the same Microcystis colony have a definite blue-green color. In well delimited colonies of Microcystis, the filaments occur in small numbers in the periphery of the jelly. A correlation appears to exist between the degree of diffluence of the sheaths and the number of Phormidium filaments present. In colonies which have become almost entirely dissociated, the filaments are often more numerous than the Microcystis cells. Where many Phormidium filaments are present, the cells of Microcystis often contain neither conspicuous pseudovacuoles nor evident cell membranes and acquire the yellowish-green color associated with the death of the organisms. From similar observations, the authors of the species supposed *P. mucicola* to be at least partially parasitic and ultimately to cause the death of the 'host' cells. Geitler in Rabenh. Kryptogamen-Fl. **14**: 999 (1932) has pointed out that the death of these cells may be due to other factors and that the Phormidium filaments may multiply and occupy the entire jelly of the 'host' colony only because the 'host' cells have disappeared from it. Specimens seen from the United States: MASSACHUSETTS: Falmouth: Coonamesset Pond, Hatchville, *H. Croasdale*, 4 Aug. 1934 (D, F, N, S, T, W); Oyster Pond, *E. T. Rose*, 17 June 1936 (D, Huber-Pestalozzi); 'Episcopal Ocean,' *A. Cohen & Drouet 1910*, 12 Aug. 1936 (D). INDIANA: with and sub. nom. *Microcystis aeruginosa*, Winona Lake, *C. M. Palmer*, 30 Aug. 1935 (D). MICHIGAN: McDonald Lake, Hastings, *G. T. Velasquez 16*, 4 Aug. 1936 (D, F, T, Y, Herb. Univ. Mich., Velasquez). IOWA: plankton from Center Lake, *G. W. Prescott 317*, 10 July 1925 (D, F); Miller's Bay, Lake Okoboji, *Prescott 316*, 30 June 1925 (D); Lake East Okoboji, *Prescott 338*, 24 June 1926 (D, N, S).

PHORMIDIUM PERSICINUM (Reinke) Gom., Ann. Sci. nat. VII Bot. **16**: 164 (1892); Davis, Phyc. Bor.-Amer. **29**: 1401 (1907), in certain specimens distributed; Tilden, Minn. Alg. **1**: 94 (1910), in part; Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913), in part.—*Fig. 6.* If a normal constituent of the flora, rarely observed or rarely attaining conspicuous growth. Some duplicate specimens of the one collection cited below contain very little if any of this species; for example, that in the Herbarium of W. R. Taylor consists almost entirely of *Oscillatoria laetevirens*. Three sheets of a collection, two in the Farlow Herbarium and one in the New York Botanical Garden, 'forming thin

layers on the glass of a marine aquarium, Woods Holl, *Trelease*, 28 Sept. 1881,' contain a small form with trichomes somewhat similar to *P. Ectocarpi* Gom, Bull. Soc. Bot. France **46**: 37 (1899), as described; but the sheaths do not color blue when treated with chlor-zinc-iodine. M. Gomont apparently saw a duplicate of this material, for one sheet in the Farlow Herbarium is annotated in Prof. Farlow's handwriting with an extract from a letter from Gomont in 1907: "Me paraît un petit Phormidium voisin de Ph. Ectocarpi Gom., Nostoc. Homo., mais la couleur différent." I am not in a position to place this material with certainty and therefore omit it here. One collection of *P. persicinum*: FALMOUTH: in a jar in the Marine Biological Laboratory, Wood's Hole, *B. M. Davis*, May 1907 (Phyc. Bor.-Amer. 1401, N, W, Y, in part; not T).

PHORMIDIUM FRAGILE (Menegh.) Gom., Ann. Sci. nat. VII Bot. **16**: 163, pl. iv, f. 13–15 (1892). [?] *P. tenue* of Hazen, RHODORA **26**: 211 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935), in part, not Gom.—Apparently confined here to saline and subsaline habitats, and often confused with *P. tenue*. The Fairhaven material is similar to that of a specimen determined by Gomont in the Farlow Herbarium, MAINE: Seal Harbor, *F. S. Collins 1867*, July 1891; the Penikese specimens are referred here though many trichomes in the masses have cells somewhat longer than broad. Specimens seen: FAIRHAVEN: tide-pools on Black Rock, *W. R. Taylor*, 31 July 1917 (T); Sconticut Point, *Drouet 2176*, 1 Sept. 1937 (D, F, N, S). GOSNOLD: on rocks in a tide pool, Penikese Island, *J. Cohn*, 10 July 1934 (D, Y); Botanical Survey of Penikese Island, 24 July 1923 (W).

PHORMIDIUM MOLLE (Kütz.) Gom., Ann. Sci. nat. VII Bot. **16**: 163, pl. iv, f. 12 (1892).—*Fig. 7*. Known from a single specimen: BOURNE: Iron Works Pond, *F. S. Collins*, 6 Aug. 1915 (N).

PHORMIDIUM TINCTORIUM Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16**: 162, pl. iv, f. 11 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 19 (1935). Authentic material: Rabenh. Alg. 1994 (F); Desmaz., Pl. cryptog. France, éd. I, 1969 (F).—One collection: GOSNOLD: penicillate tufts attached to decaying sticks in a well-hole the water of which empties into Sheep Pond, Cuttyhunk Island, *Drouet 1004*, 1 July 1930 (T, D).

PHORMIDIUM LURIDUM (Kütz.) Gom., Ann. Sci. nat. VII Bot. **16**: 165, pl. iv, f. 17, 18 (1892). Authentic material: Desmaz., Pl. cryptog. France, sér. II, 129 (F).—Known from one station: FALMOUTH: lining concrete tanks beneath benches in greenhouse south of railroad station, Woods Hole, *Drouet 1931*, 27 Aug. 1936 (D, F, T, Y).

PHORMIDIUM TENUE (Menegh.) Gom., Ann. Sci. nat. VII Bot. **16**: 169, pl. iv, f. 23–25 (1892); Nott, Phyc. Bor.-Amer. **13**: 606 (1899), at least in part; Tilden, Minn. Alg. **1**: 98 (1910); Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935); not of Hazen, RHODORA **26**: 211 (1924). *P. angustissimum* of Croasdale, ibid. 19 (1935), not West & West f., ex char. Authentic material: Rabenh. Alg. 268 (F),

1730 (F, T).—Often seen in fresh water and very rarely in slightly brackish water. Phyc. Bor.-Amer. 606 consists of a considerable number of species of algae not carefully dried and partially overgrown by fungi. The masses of trichomes purported to be *P. tenue* are at most in a juvenile state and are scarcely sufficiently large for critical study. Morphologically the trichomes seem referable rather to *P. tenue* than to *P. angustissimum* as described. Specimens seen: FALMOUTH: on sides of a watering-trough, Woods Hole, *Drouet 1905*, 5 Aug. 1936 (D, F, S, T, Y). GOSNOLD: Deer Pond, Nonamesset Island, *H. Croasdale*, 2 July 1934 (D, Y); pool, east shore of Naushon Island, *C. P. Nott*, 9 Aug. 1895 (W, *Specim. mancum*); in fresh water, Naushon Island, *C. P. Nott*, 9 Aug. 1895 (Phyc. Bor.-Amer. 606, W, T, Y, *specim. manca*).

PHORMIDIUM VALDERIANUM Gom.,[12] Ann. Sci. nat. VII Bot. **16**: 167, pl. iv, f. 20 (1892). Authentic material: Rabenh. Alg. 577 (F), 2458 (F); Hauck & Richt., Phyk. univ. 29 (F).—In fresh water. In the authentic material cited above, in the many specimens of this species from Europe and America studied during preparation of this paper, and in Gomont's illustration (loc. cit.) of this species, I have been unable to discover the constrictions of the trichomes as described by Copeland, Ann. New York Acad. Sci. **36**: 179 (1936). The material which Croasdale reported as 'rare' in Chara Pond near Woods Hole in her *Fresh Water Alg. Woods Hole, Mass.*, 20 (1935), has been lost; I have not had the opportunity to examine it. The one collection seen lined a trough through which hot and cold water ran intermittently: FALMOUTH: Ice House Pond, *E. T. Rose*, 25 June 1936 (D, F, T, Y).

PHORMIDIUM CORIUM (Ag.) Gom. ex Ann. Sci. nat. VII Bot. **16**: 172, pl. v, f. 1, 2 (1892). Authentic material: Rabenh. Alg. 294 (F, T), 392 (F).—Growing subaerially in leathery sheets, or in thick compact strata beneath the surface of fresh water. *P. inundatum*, *P. papyraceum*, and *Symploca muralis* are sometimes confused with this species. Specimens seen: FAIRHAVEN: lining walls of a cow-trough and well by Highway 6 east of Fairhaven, *E. T. Rose & Drouet 1889*, 18 July 1936 (D, F, T, Y). TISBURY: on stones in springy margins of south end of Lake Tashmoo, *G. Velasquez & Drouet 1894*, 21 July 1936 (D, S).

PHORMIDIUM PAPYRACEUM (Ag.) Gom., Ann. Sci. nat. VII Bot. **16**: 173, pl. v, f. 3, 4 (1892). Authentic material: Wittr. & Nordst., Alg. exs. 776a, b (F); Rabenh. Alg. 2089 (F); Hauck & Richt., Phyk. univ. 223 (F).—Forming dark blue-green sheets in almost fresh water of high tide pools (diluted with rain water), or in comparable situations in which the salt content of the water is low. Specimens in herbaria come also from strictly freshwater habitats. *P. papyraceum* is reported by Taylor, RHODORA 26: 212 (1924), from Penikese Island; unfortunately the specimen has been misplaced. Specimens seen:

[12] This name is incorrectly written *P. valderianum* (Delp.) Gom. in recent phycological literature.

FAIRHAVEN: in high tide pools, Sconticut Point, *Drouet 1879, 1880*, 15 July 1936 (D, F, S, T, Y).

PHORMIDIUM RETZII (Ag.) Gom. ex Ann. Sci. nat. VII Bot. **16:** 175, pl. v, f. 6–9 (1892); Collins, Phyc. Bor.-Amer. **35:** 1710 (1911); not of Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935). Authentic material: Kütz. Dec. 15 (F); Moug. & Nestl., Stirp. crypt. vogeso-rhenanae 1375 (F).—One collection seen: EASTHAM: forming sheaths on stalks of plants in shallow water, Great Pond, *F. S. Collins*, 9 Sept. 1910 (Phyc. Bor.-Amer. 1710, W, T, Y).

PHORMIDIUM AMBIGUUM Gom., Ann. Sci. nat. VII Bot. **16:** 178, pl. v, f. 10 (1892). *Lyngbya semiplena* of Nott, Phyc. Bor.-Amer. **30:** 1452a (1908); not of Setchell, idem 1452b (1908); not J. Ag. ex Gom. Authentic material: Rabenh. Alg. 75 (F, T), 265 (F), 1956 (F); Wittr. & Nordst., Alg. exs. 492 (F).—Specimens seen, all apparently from fresh water: FALMOUTH: on stones in running water flowing from pond to the sea, 'Megantic,' Buzzards Bay, *W. G. Farlow*, Aug. 1913 (F); on mud and debris in shallow water, Wood Pond, Woods Hole, *Drouet 1107*, 23 June 1934 (D, F, T, Y); ditch, Falmouth, *C. P. Nott*, 20 July 1895 (W), July 1895 (Collins, N. Amer. Alg. 12, D), undated (Phyc. Bor.-Amer. 1452a, not b, W, T, Y).

PHORMIDIUM AUTUMNALE (Ag.) Gom., Ann. Sci. nat. VII Bot. **16:** 187, pl. v., f. 23, 24 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935). *P. favosum* of Collins, Phyc. Bor.-Amer. **34:** 1852 (1910), not Gom. *Lyngbya hahatonkensis* Drouet,[13] Bot. Gaz. **95:** 698, f. 5 (1934). Authentic material: Kütz. Dec. 94 (F); Rabenh. Alg. 2537 (F); Hauck & Richt., Phyk. univ. 233 (F).—Often developing on soil in and about temporary rain pools, rarely in subaerial subsaline habitats, and not seldom appearing in soil cultures. Specimens seen: EASTHAM: forming a thin glossy coating on wall of a spring at high water mark, shore of Salt Pond, *F. S. Collins*, 11 Sept. 1910 (Phyc. Bor.-Amer. 1652, W, T, Y). FALMOUTH: subaerial on wet soil behind Zoology Building, Woods Hole, *Drouet 1926*, 22 Aug. 1936 (D, F, T, Y); in clay drain pipe beside Eel Pond, Woods Hole, *Drouet 1183*, 30 July 1934 (D); on wet earth in greenhouse south of railroad station, Woods Hole, *Drouet 1932*, 27 Aug. 1936 (D); damp ground near a pump, Wood's Holl, *W. A. Setchell*, July 1894 (W); on wet soil in greenhouse at railroad station, Falmouth, *Drouet 1936*, 29 Aug. 1936 (D); in greenhouse by State Road at Church Street, Woods Hole, *Drouet 1930*, 26 Aug. 1936 (D).

PHORMIDIUM SUBMEMBRANACEUM (Ard. & Straff.) Gom., Ann. Sci. nat. VII Bot. **16:** 180, pl. v, f. 13 (1892); Osterhout & Gardner, Phyc.

[13] The TYPE material of this species, MISSOURI: Hahatonka, *Drouet 148*, 9 Aug. 1928, in Herb. F. Drouet, should more reasonably be considered an ecological or growth form of *P. autumnale* than a species of Lyngbya. The shortness of the cells can easily be attributed to a high rate of cell division taking place in a rapidly developing plant mass. The trichomes in other respects appear to be identical with authentic material of *P. autumnale*. Thick and mucous sheaths are seen in other material of this species growing in almost or partially submersed habitats.

Bor.-Amer. **24**: 1162 (1904); Tilden, Minn. Alg. **1**: 104 (1910); Geitler, Rabenh. Kryptogamen-Fl. **14**: 1023 (1932); Frémy, Mém. Soc. nat. Sci. nat. & math. Cherbourg **41**: 91 (1834). *Oscillatoria* (*Oscillaria*) *subtorulosa* Farlow (as to specimens, not as to name-bearing synonym of *Phormidium subtorulosum* Bréb. ex Gom.) apud Tilden, Minn. Alg. **1**: 83 (1910); Farlow, Mar. Alg. New Engl., 33 (1891); not of Davis, Bull. U. S. Bur. Fish. 1911(2): 797 (1913).—In a letter to Prof. Farlow presumably written in August, 1899, M. Gomont speaks of the former's collection from Eastport, Maine, labeled *Oscillaria subtorulosa*, a portion of which he examined and returned:[14] "Votre plante est un Phormidium, épais de 3–4 μ, à articles carré, à extrémité droite, avec un coiffe. Il ressemble beaucoup au Phormidium submembranaceum (Oscill. Ardissone) et je crois qu'on peut le réunir à cette espèce dont je n'ai vu qu'un seul echantillon, celui d'Ardissone." This specimen and other New England material appear to be exactly similar in every morphological detail except range in size to Phyc. Bor.-Amer. 1162 from California, the apparent basis for the citation of this species from North America by Geitler, loc. cit., and by Frémy, loc. cit. The species is one of truly marine waters, often found mixed with other algae on piers, wharves, barnacles, and rocks both between and below tide marks. Prof. Frémy has examined a portion of Farlow's material of *O. subtorulosa*. Specimens seen from North America: MAINE: Eastport, *W. G. Farlow*, Oct. 1875 (F, P, Y). MASSACHUSETTS: Medford: *F. S. Collins*, 21 May 1877 (N). Falmouth: on government wharf, Wood's Holl, *W. G. Farlow*, Aug. 1876 (F); on barnacles from planks, Eel Pond, Woods Hole, *W. R. Taylor*, 18 July 1925 (T); on barnacles, bridge at entrance to Eel Pond, Woods Hole, *W. R. Taylor*, 22 July 1921 (T); on pilings, Penzance Garage, Woods Hole, *Drouet 2131*, 14 Aug. 1937 (D, F, N, S, W). RHODE ISLAND: Newport, *I. Holden*, 9 May 1896 (F). CONNECTICUT: Black Rock, Bridgeport, *I. Holden*, 20 July 1892 (F, N). CALIFORNIA: Alameda, *W. J. V. Osterhout & N. L. Gardner*, 26 Sept. 1903 (Phyc. Bor.-Amer. 1162, T, Y).

OSCILLATORIA Vauch. ex Gom., Ann. Sci. nat. VII Bot. **16**: 198 (1892). *Oscillaria* of various authors.—One must be exceedingly careful, before determination of species in this and other genera is attempted, to exclude material in the hormogonial condition. Often thin and mucous sheaths are secreted about the hormogonia and give the appearance of a phormidioid or lyngbyoid plant mass. With the trichomes broken into short segments, the chances of discovering the maturely developed apices become very rare.[15]

[14] M. Gomont's letters to Prof. Farlow are to be found on file with other scientific correspondence of the latter in the Farlow Reference Library of Harvard University.

[15] Certain characters other than those employed in this paper have been suggested (see Geitler, Rabenh. Kryptogamen-Fl. **14**. 1930–32) as having taxonomic importance in the genus Oscillatoria: the direction of rotation of the living trichomes, the refraction of blue light by the cell-membranes or unseen sheaths, the reversible vacuolization of the protoplasm ('keritomy'), the presence of refractive accumulations within

Certain species often encountered in North America are here omitted from treatment because of absence of preserved material from southern Massachusetts; among these are *O. sancta* Kütz. ex Gom., *O. limosa* Ag. ex Gom., *O. curviceps* Ag. ex Gom., *O. rubescens* DC. ex Gom., *O. prolifica* (Grev.) Gom., *O. Agardhii* Gom., *O. animalis* Ag. ex Gom., *O. chalybea* Mert. ex Gom., *O. Okeni* Ag. ex Gom., *O. terebriformis* Ag. ex Gom., and *O. Grunowiana* Gom. I have been unable to locate the material upon which Croasdale based her reports of *O. nigra* and *O. angustissima* in *Fresh Water Alg. Woods Hole, Mass.*, 17 (1935) and hence exclude such reports from treatment here. *O. subuliformis* of Hazen, RHODORA 26: 215 (1924), is considered in this paper under *O. brevis* var. *neapolitana*.

KEY TO SPECIES

I. Forms with large trichomes (6–60 μ in diameter), the majority of cells in the plant mass less than 1/3 as long as wide
  A. Plants strictly of fresh water, rarely found in secondarily brackish water
    1. Cross-walls never granulated; apices of trichomes capitate or subcapitate
      a. Plant-mass dark blue-green; trichomes dark blue-green, straight, rigid, fragile, not constricted at the cross-walls, 16–60 (usually 25–50) μ in diameter, at the apices somewhat attenuate and more or less uncinate, subcapitate and uncinate; cells 1/4–1/11 as long as wide; protoplasm finely, often coarsely, granulose; apical cell convex, without calyptra ..... *O. princeps*
      b. Plant-mass dark blue-green; trichomes bright blue-green, often mixed sparingly with other algae, straight or subflexuous, here and there uncinate-spiraled, never constricted at the cross-walls, 12–15 μ in diameter, at the apices briefly and often conspicuously attenuate-capitate, or truncate and uncinate or loosely terebriform; cells 1/3–1/6 (usually 1/4) as long as wide, 2–4 μ long; protoplasm finely granulose; cross-walls conspicuous, never granulated; membrane of the apical cell convex and slightly thickened ..... *O. proboscidea*
    2. Cross-walls always granulated; apices of trichomes capitate only in *O. anguina*
      a. Stratum blackish-green; trichomes somewhat torulose, straight below but somewhat spiraled and uncinate toward the apices, long and very slightly attenuated, not capitate, 9–11 μ in diameter; cells 1/2–1/6 as long as wide; apical cell rotund, without calyptra ..... *O. ornata*
      b. Stratum blackish-green; trichomes straight below,

---

or in conjunction with the apical cells, the thickness of cross-walls, and the presence of 'intercellular spaces.' Extended studies of such characters in well authenticated material of the more common species are much to be desired.

uncinate or conspicuously spiraled above, somewhat long-attenuate, obtusely capitate, not constricted at the cross-walls, 6–8 μ in diameter; cells 1/3–1/6 as long as wide; apical cell enlarged, rotund, the outer membrane thickened ..... *O. anguina*

B. Plants strictly of salt or brackish water, rarely if ever found in fresh water

1. Plant-mass black; trichomes bright olive-green, straight, fragile, torulose, at the apices attenuate and noticeably arcuate, 17–29 μ in diameter; cells 1/3–1/7 as long as wide; protoplasm finely granulose; cross-walls coarsely granulated; apical cell rotund, seemingly capitate, the outer membrane thickened into a conspicuous convex calyptra ..... *O. margaritifera*

2. Plant-mass blackish or olive-green; trichomes olive-green, elongate, straight, torulose, toward the apices long and conspicuously attenuate and arcuate, 7–11 μ in diameter; cells 1/2–1/4 as long as wide; cross-walls conspicuously granulated; apical cell seemingly subcapitate, rotund, the outer membrane thickened ..... *O. nigro-viridis*

II. Forms with small trichomes (10 μ or less in diameter); the greater number of cells in the plant mass more than 1/3 as long as wide

A. Trichomes not attenuate at the apices, nor capitate with an enlarged apical cell

1. 1. Cells quadrate and shorter than wide.—Plant-mass bright or dark blue-green, in fresh water; trichomes brilliantly blue-green, straight, fragile, constricted at the cross-walls, straight or arcuate at the apices, 4–10 μ in diameter; cells subquadrate to 1/3 as long as wide; protoplasm coarsely granulose; cross-walls conspicuously granulated; apical cell rotund, with a thickened outer membrane ..... *O. tenuis*

2. Cells quadrate and longer than wide

a. Stratum thin and web-like, yellowish-green, in fresh water; trichomes greenish-yellow, straight or curved, often arcuate at the apices, not constricted at the cross-walls, 3.5–4 μ in diameter; cells subquadrate to twice as long as wide; protoplasm scarcely granulose; cross-walls pellucid, ungranulated; apical cell rotund at the apex, without calyptra ..... *O. chlorina*

b. Stratum thin, bright blue-green, in fresh or brackish water; trichomes very pale green, straight, fragile, not constricted at the cross-walls, arcuate at the apices, 2–3 μ in diameter; cells 2–3 times as long as wide; protoplasm scarcely granulose; cross-walls usually marked with two large protoplasmic granules; apical cell rotund above, without calyptra ..... *O. amphibia*

B. Mature trichomes attenuate at the apices

1. Trichomes capitate with an enlarged apical cell.—Plant-mass bright blue-green, thin, in fresh water; trichomes pale blue-green, straight or flexuous, elongate, not constricted at the cross-walls, long-attenuate and conspicuously capitate at the apices, 2–3 μ in diameter; cells rarely subquadrate, up to 4 times as long as wide; protoplasm homogeneous;

cross-walls granulated; apical cell enlarged above, without calyptra ..... *O. splendida*

2. Trichomes not capitate with an enlarged apical cell
   a. Trichomes not constricted at the cross-walls
      (I) Apical cell truncate.—Stratum bright blue-green, in fresh or brackish water; trichomes bright blue-green (rarely yellowish-green or lead-colored), straight or undulate below, long-attenuate and briefly uncinate or spiraled at the apices, 3–5 μ in diameter; cells as a rule subquadrate, often longer or shorter than wide, 2–6 μ long; protoplasm finely granulose; cross-walls often conspicuous, often coarsely granulated; apical cell truncate, the outer membrane somewhat thickened ..... *O. granulata*
      (II) Apical cell acute-conical.—Stratum olive-green; trichomes blue-green, straight, briefly and subacutely attenuated and uncinate or spiraled at the apices, 4–6.5 μ in diameter; cells 1/3–1/2 as long as wide, protoplasm finely granulose; cross-walls not granulated; calyptra absent
         (A) Freshwater form, with trichomes 4–5 μ in diameter, the apices uncinate ..... *O. brevis*
         (B) Brackish or salt water form, with trichomes 5–6.5 μ in diameter, the apices uncinate or spiraled ..... *O. brevis* var. *neapolitana*
   b. Trichomes constricted at the cross-walls, at least at the apices
      (I) Stratum yellowish or yellow-green, thin, not rarely almost membranaceous, fragile, submersed in brackish water, rarely emersed and subaerial, usually intermixed with various other Oscillatoriaceae; living trichomes yellow-green, straight, rarely somewhat flexible, fragile, evidently constricted at the cross-walls, never torulose, 3–5 μ in diameter, straight or rarely scarcely curved or uncinate at the apices, very briefly attenuate; cells subquadrate to 1/3 as long as wide, 1.5–5.5 μ long; protoplasm finely granulose throughout the cell; cross-walls conspicuous, pellucid, never granulated; apical cell obtusely cylindric-conical, never capitate or calyptrate ..... *O. luteola*
      (II) Stratum bright green, in salt water; trichomes somewhat yellowish-green or blue-green, straight, fragile, slightly constricted at the cross-walls or almost torulose, briefly attenuate and undulate or uncinate at the apices, 3–5 μ in diameter; cells subquadrate; protoplasm uniformly granulose; cross-walls evident, sometimes punctate; apical cell more or less obtuse to subacute-conical, without calyptra ..... *O. laetevirens*
      (III) Stratum blue-green, in fresh water; trichomes straight, elongate, usually constricted at the cross-walls and always so at the apices, briefly and subobtusely attenuate and uncinate, 4–6 μ

in diameter; cells quadrate to 1/2 as long as wide; protoplasm finely granulose; cross-walls granulated; apical cell blunt-conical, without calyptra ..... *O. formosa*

OSCILLATORIA PRINCEPS Vauch. ex Gom., Ann. Sci. nat. VII Bot. **16**: 206, pl. vi, f. 9 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935). *Lyngbya gigantea* Lewis, Zirkle & Patrick,[16] Journ. Elisha Mitchell Sci. Soc. 1933: 221, pl. 16, f. 7 (1933). Authentic material: Farl., Anders. & Eat., Alg. Am. Bor. Exs. 177 (F, Y); Rabenh. Alg. 580 (T), 1122 (F), 1218 (F), 2535 (F, T); Wittr. & Nordst., Alg. exs. 393a, b (F).—Not uncommon in quiet fresh water. Specimens seen: FALMOUTH: in a pond, *H. Croasdale*, 16 July 1934 (D); cranberry pond north of West Falmouth, *E. T. Rose*, 13 July 1936 (D, N, S); Beebe's Pond near Falmouth, *H. Croasdale* (W); waterhole in bog near Chara Pond, *Drouet 1942*, 14 Sept. 1936 (D). DARTMOUTH: in a pond 1 mile south of Nonquitt, *E. T. Rose & Drouet 1890*, 18 July 1936 (D, F, T, Y).

OSCILLATORIA PROBOSCIDEA Gom., Ann. Sci. nat. VII Bot. **16**: 209, pl. vi, f. 10, 11 (1892). Authentic material: Rabenh. Alg. 2535 (F).—In fresh water: FALMOUTH: Shiverick Pond, *Drouet 2180*, 4 Sept. 1937 (D, F, N, S); on submerged water plants in sewage, 'Episcopal Ocean,' *E. T. Rose & Drouet 1869*, 4 July 1936 (D, F, S, T, Y).

OSCILLATORIA ORNATA Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16**: 214, pl. vi, f. 15 (1892). Authentic material: Moug. & Nestl., Stirp. crypt. vogeso-rhenanae 898 (N, in part, not F).—Specimens seen: GOSNOLD: Cuttyhunk, *W. R. Taylor*, 27 July 1926 (T). DARTMOUTH: with *O. princeps* in a pond 1 mile south of Nonquitt, *E. T. Rose & Drouet 1890*, 18 July 1936 (D, F, T, Y).

OSCILLATORIA ANGUINA Bory ex Gom., Ann. Sci. nat. VII Bot. **16**: 214, pl. vi, f. 16 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935).—Often abundant in masses of other algae in ponds and bogs. Specimens seen: FALMOUTH: Fresh Pond, Nobska Point, *Drouet 1949*, 16 Sept. 1936 (D); with *Phormidium ambiguum* on mud and debris in shallow water, Wood Pond, Woods Hole, *Drouet 1107*, 23 June 1934 (D). GOSNOLD: Pink Pond, Nonamesset Island, *H. Croasdale*, 2 July 1934 (D); with other algae on the bottom of Nashawena Pond, Nashawena Island, *Drouet 1874*, 8 July 1936 (D, F, N, S, T, Y).

OSCILLATORIA MARGARITIFERA Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16**: 216, pl. vi, f. 19 (1892); Taylor and Hazen, RHODORA **26**: 212, 215 (1924), in part; Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935), in part; not of Collins, Phyc. Bor.-Amer. **35**: 1708a, b (1911). Authentic material: Hauck & Richt., Phyk. univ. 474

[16] I am indebted to the authors, and especially to Dr. Conway Zirkle, for the privilege of examining the TYPE material of this species. I interpret the specimens as trichomes of *O. princeps* in the hormogonial state, as the description and figure suggest.

(F, in part).—Forming slimy black expansions in shallow salt marshes and brackish ponds; often seen mixed with other algae in similar habitats. *Hydrocoleum glutinosum* and *H. Holdenii*, which are probably more abundant in salt marshes about Woods Hole than is *O. margaritifera*, are often mistaken for this species. Specimens seen: FALMOUTH: on bottom of Mill Pond, Woods Hole, *Drouet 1945*, 17 Sept. 1936 (D, F, N, S, T, Y), *Drouet 2178*, 2 Sept. 1937 (D, N, S). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W); on bottom and floating in Tub Pond north, Penikese Island, *Drouet 1864*, 1 July 1936 (D, N, S).

OSCILLATORIA NIGRO-VIRIDIS Thw. ex Gom., Ann. Sci. nat. VII Bot. **16**: 217, pl. vi, f. 20 (1892). *O. lactevirens* of Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913), not Crouan ex Gom. Authentic material: Hauck & Richt., Phyk. univ. 186 (F).—Often found floating, or covering rocks, woodwork, barnacles, or other algae in quiet salt, seldom in brackish, water. Our specimens from salt water invariably measure 7 μ in diameter, the lower limit of measurement as described by Gomont; in only one specimen seen, my *1934* from brackish water cited below, do the trichomes approach the maximal width of 11 μ. Gomont described this species as inhabiting typically, "ad summum limitem maris, palos, portuum muros, rupes limosas, necnon ostia coenosa fluminum," etc. and *O. Corallinae* Gom., distinguished from *O. nigro-viridis* by the habit of growth and the type of protoplasmic granulation, as typically "in Corallinis aliisque algis necnon Zoophytis parasitica, infra limitem superiorem maris," etc. On the New England coast, at least, the same morphological type grows indiscriminately upon rocks, wood, attached animals, and other algae, usually at low tide level. Often the cross-walls are not as conspicuously granulated as in Gomont's figure of *O. nigro-viridis* and in the authentic material cited above, but much more so than in Crouan, Alg. Mar. Finistère 329 (F), cited as authentic material of *O. Corallinae*. Material from collections cited below has been seen by Prof. Frémy and Prof. Geitler. Specimens examined: FALMOUTH: on woodwork, Eel Pond, Woods Hole, *F. S. Collins*, 15 Aug. 1904 (as *O. lactevirens*, N), *Drouet 1119*, 27 June 1934 (D); on government wharf at high water mark, Wood's Holl, *W. G. Farlow*, Aug. 1876 (F); on submerged Fucus, Eel Pond, Woods Hole, *Drouet 1203*, 29 July 1934 (D); on Enteromorpha, Eel Pond, Woods Hole, *Drouet 1012*, 12 July 1930 (D); on stumps of Spartina etc. in a pool south of Chara Pond, *Drouet 1934*, 18 Aug. 1936 (D, F). OAK BLUFFS: on algae dredged off East Chop, *H. Croasdale*, 15 July 1930 (D). FAIRHAVEN: on Rhizoclonium and rocks, tide pool, Black Rock, *Drouet 1196*, 22 July 1934 (D, F, N, T, Y, Frémy, Geitler); Sconticut Point, *Drouet 1218*, 22 July 1934 (D).

OSCILLATORIA TENUIS Ag. ex Gom., Ann. Sci. nat. VII Bot. **16**: 220, pl. vii, f. 2, 3 (1892); Hazen, RHODORA **26**: 211 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935). *O. limosa* of Wolle,

Fresh Water Alg. U. S. 313 (1887), in part, not Ag. ex Gom. *O. tenuis* var. *tergestina* of Croasdale, loc. cit. (1935). *O. brevis* of Croasdale, ibid. 18 (1935), not Kütz. ex Gom. Authentic material: Kütz. Dec. 34 (F); Rabenh. Alg. 50 (F), 1016 (F), 1599 (T).—Var. NATANS (Kütz.) Gom., ibid. 221, with trichomes 6–10 μ in diameter, and var. TERGESTINA (Kütz.) Rabenh. ex Gom., loc. cit., with trichomes 4–6 μ in diameter, are both abundantly represented in the freshwater collections. The two varieties are as a rule present in the same collections, but in variable proportions in different collections. The var. *natans* may sometimes be confused with *O. ornata*. Specimens seen: [?] EASTHAM: pond 10 miles south of Truro, *E. T. Rose*, 12 July 1936 (D, F, S, T, Y). FALMOUTH: in shallow water of Iron Pond, Woods Hole, *Drouet 1939*, 12 Sept. 1936 (D, N); floating on a pool across from Cedar Swamp, Woods Hole, *Drouet 1940*, 13 Sept. 1936 (D, F, N, S, T, Y); in a shallow pond by Quisset Avenue north of Golf Course, Woods Hole, *Drouet 1906*, 5 Aug. 1936 (D, N, S); Shank's Little Pond, Falmouth, *H. Croasdale*, 4 Aug. 1934 (D); subaerial on mud, Wood Pond, Woods Hole, *Drouet 1918*, 17 Aug. 1936 (D); muddy shore of Shiverick Pond, Falmouth, *Drouet 1230*, 8 Aug. 1934 (D); High Hat Pond, *H. Croasdale*, 31 July 1934 (D). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W). FALL RIVER: Fall River (Wolle Collection, P).

OSCILLATORIA CHLORINA Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16**: 223 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935).—*Fig. 8 and 9.* Occasionally seen in freshwater ponds. In drying, the trichomes become bright yellow in color. This color is not always produced, however, if the material is dried after a long period of preservation in formalin. See Geitler, Rabenh. Kryptogamen-Fl. 14: 952 (1932). Specimens seen: FALMOUTH: pond at dump on Gifford Street, Falmouth, *H. Croasdale*, 29 June 1934 (D, W); pond on Whitamore Estate, Woods Hole, *H. Croasdale*, 2 Aug. 1934 (D, F, S, T, Y); with *O. princeps* in a cranberry pond north of West Falmouth, *E. T. Rose*, 13 July 1936 (D).

OSCILLATORIA AMPHIBIA Ag. ex Gom., Ann. Sci. nat. VII Bot. **16**: 221, pl. vii, f. 4, 5 (1892); Hazen, RHODORA **26**: 211 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935); not of Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913). Authentic material: Kütz. Dec. 129 (F); Wittr. & Nordst., Alg. exs. 997 (F).—Mixed with other algae in fresh and brackish water. Specimens seen: GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W); Penikese Island, *T. Hazen*, 1923 (T); Pasque Island, *H. Croasdale*, 24 June 1930 (D); small pond on northeastern Pasque Island, *Drouet 1873*, 8 July 1936 (D, F, T, Y).

OSCILLATORIA SPLENDIDA Grev. ex Gom., Ann. Sci. nat. VII Bot. **16**: 224, pl. vii, f. 7, 8 (1892); Hazen, RHODORA **26**: 211 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). Authentic material: Wittr. & Nordst., Alg. exs. 784 (F); Rabenh. Alg. 161 (F),

329 (F); Hauck & Richt., Phyk. univ. 475 (F).—Common in the freshwater collections. Specimens seen: FALMOUTH: Fresh water, Woods Holl, *Trelease*, 1881 (F); in Shank's Little Pond, *H. Croasdale*, 12 Aug. 1934 (D, S); Oyster Pond, *H. Croasdale*, 12 Aug. 1931 (D, Y), *Drouet 1110*, 18 June 1934 (D, F, T); south shore, Nobska Pond, *E. T. Rose*, 18 June 1936 (D); in shallow water of Iron Pond, Woods Hole, *Drouet 1939*, 12 Sept. 1936 (D). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W).

OSCILLATORIA GRANULATA Gardn., Mem. New York Bot. Gard. **7:** 37, pl. 8, f. 71 (1927); descr. emend. Drouet, RHODORA **39:** 278, f. 2 (1937).—Common in shallow freshwater and secondarily brackish pools along the seashore. I have already noted (loc. cit.) the geographic distribution of this species. Additional material from southern Massachusetts: FALMOUTH: in swampy area north of Nobska Point, *Drouet 2079*, 5 July 1937 (D, N, S). GOSNOLD: in bog above Tarpaulin Pond, Naushon Island, *Drouet 2126*, 12 Aug. 1937 (D, F, N, S).

OSCILLATORIA BREVIS Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16:** 229, pl. vii, f. 14 (1892); not of Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). Authentic material: Rabenh. Alg. 30 (F, T). —Usually found on wet soil or in temporary pools of fresh water. Specimens seen: FALMOUTH: on wet soil in greenhouse at railroad station, Falmouth, *Drouet 1936*, 29 Aug. 1936 (D). FAIRHAVEN: on mud about a well and cow-trough by Highway 6 east of Fairhaven, *E. T. Rose & Drouet 1888*, 18 July 1936 (D, N, S).

OSCILLATORIA BREVIS var. NEAPOLITANA (Kütz.) Gom., Ann. Sci. nat. VII Bot. **16:** 229, pl. vii, f. 15 (1892). *O. subuliformis* of Hazen, RHODORA **26:** 215 (1924); of Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935); not Kütz. ex Gom. Authentic material: LeJolis, Alg. mar. Cherbourg 174 (F).—Frequent in brackish water, often mixed with other algae. Specimens seen: FALMOUTH: floating in a brackish pool south of Chara Pond, *Drouet 1921*, 18 Aug. 1936 (D, S); subaerial on mud, Gardiner's Ditch, Woods Hole, *Drouet 1197*, 22 July 1934 (D, T, W). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W); Penikese Island, *T. Hazen*, 1923 (T).

OSCILLATORIA LUTEOLA Drouet, RHODORA **39:** 277, f. 1 (1937). *Oscillatoria* sp. of Hazen, RHODORA **26:** 215 (1924). Authentic material: Phyc. Bor.-Amer. 710 (W, T, Y), 1054 (W, T, Y).—Very common and abundant in quiet brackish water. Southern Massachusetts specimens in addition to those cited with the original description: FALMOUTH: floating on brackish water, Gardiner's Ditch, Woods Hole, *Drouet 2087*, 13 July 1937 (D); in brackish water of ditches about Mill Pond, Woods Hole, *Drouet 2179*, 2 Sept. 1937 (D, F, N, S).

OSCILLATORIA LAETEVIRENS Crouan ex Gom., Ann. Sci. nat. VII Bot. **16:** 226, pl. vii, f. 11 (1892); not of Davis, Bull. U. S. Bur. Fish 1911(2): 798 (1913). *Phormidium persicinum* of Davis, Phyc. Bor.-Amer. **29:** 1401 (1907), in part, not Gom.—On rocks and woodwork

between tide limits. Our material is very similar to that in a specimen collected by Crouan at Brest and obligingly transmitted to me by Prof. Frémy. Specimens seen: FALMOUTH: on rocks in spray of drain from Supply Department Building, Eel Pond, Woods Hole, *Drouet 1904*, 2 Aug. 1936 (D, F, N, S, T, Y); jar in Marine Biological Laboratory, *B. M. Davis*, May 1907 (Phyc. Bor. Amer. 1401, T; and in part, W, N, Y).

OSCILLATORIA FORMOSA Bory ex Gom., Ann. Sci. nat. VII Bot. **16:** 230, pl. vii, f. 16 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). Authentic material: Moug. & Nestl., Stirp. crypt. vogeso-rhenanae 898 (F, N); Wittr. & Nordst., Alg. exs. 677 (F).—Not common in freshwater ponds. The two specimens are from the same locality: FALMOUTH: 'Desmid Haven' Pond, near West Falmouth, *H. Croasdale*, July 1935 (D), *C. M. Palmer*, 27 July 1936 (D).

SPIRULINA Turp. ex Gom., Ann. Sci. nat. VII Bot. **16:** 249 (1892); emend. G. Schmidt apud Geitler, Beih. z. bot. Centralbl. II, **41:** 283 (1925). *Arthrospira* Stizenb. ex Gom., ibid., 246 (1892).—It is doubtful, in light of the recent work on the morphology of the trichome in this group,[17] that distinct genera can still be retained for the septate and non-septate forms, as Geitler has repeatedly pointed out. In this paper I do not include treatment of *S. tenerrima* Kütz. ex Gom., which Gomont (ibid. 253) cites from the United States, and *S. Gomontiana* (Setch.) Geitl., reported by Hazen (as *Arthrospira Gomontiana* Setch.) in RHODORA **26:** 215 (1924) from brackish water on Penikese Island; I have seen material of neither of these species from southern Massachusetts.

KEY TO SPECIES

I. Spirals loose, i.e., not touching each other
  A. Spiral irregular.—Trichomes 1.2–1.8 μ in diameter, the spirals 3.2–5 μ in diameter, 3–5 μ or more apart . . . . *S. Meneghiniana*
  B. Spiral regular
    1. Trichomes pale blue-green, 1.2–1.7 μ in diameter, the spirals 2.5–4 μ in diameter, 2.7–6 μ apart . . . . . *S. major*
    2. Trichomes blue-green, 1.5–2 μ in diameter, the spirals 7.5–11.5 μ in diameter, 20–28 μ apart . . . . . *S. stagnicola*
II. Spirals touching each other.—Plant-mass bright blue-green; trichomes pale blue-green, 1–2 μ in diameter, the spirals 3–5 μ in diameter, contiguous or here and there scarcely separated . . . . . *S. subsalsa*

SPIRULINA MENEGHINIANA Zanard. ex Gom., Ann. Sci. nat. VII Bot. **16:** 250, pl. vii, f. 28 (1892). Authentic material: Rabenh. Alg. 895 (F), 1015 (F).—Apparently uncommon in brackish habitats and seen in only two specimens: FALMOUTH: 'occasional filaments of a fine loose Spirulina,' West Falmouth, *F. S. Collins*, 10 Aug. 1883 (N); West Falmouth, *F. S. Collins*, 10 Aug. 1883 (N).

[17] See list of major works in Crow, Trans. Amer. Microsc. Soc. **46:** 139–148 (1927), and in Geitler, Rabenh. Kryptogamen-Fl. **14:** 917 (1932).

SPIRULINA MAJOR Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16**: 251, pl. vii, f. 29 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). *S. tenuissima* of Hazen, RHODORA **26**: 215 (1924); Croasdale, loc. cit. (1935); not Kütz. ex Gom. *S. densa* Lillick,[18] Amer. Midland Nat. **16**: 210, f. 1A (1935). Authentic material: Hauck & Richt., Phyk. univ. 38 (F); Rabenh. Alg. 250 (F).—Not commonly seen in the southern Massachusetts flora except among other algae in quiet brackish water. The species is widely distributed in inland freshwater habitats. Specimens seen: FALMOUTH: with other Myxophyceae floating in Gardiner's Ditch, Woods Hole, *Drouet 1134*, 30 June 1934 (D, F, T, Y); Penzance salt marsh, Woods Hole, *E. T. Rose*, 13 July 1936 (D); in ditch at east end of Mill Pond, Woods Hole, *Drouet 2085*, 9 July 1937 (D, N, S). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W); Penikese Island, *T. Hazen*, 1923 (T).

SPIRULINA STAGNICOLA Drouet, Rhodora **39**: 279, f. 3 (1937).—One collection from brackish water: GOSNOLD: Nonamesset Island, *E. T. Rose*, 21 June 1936 (TYPE in Herb. F. Drouet; ISOTYPES: F, N, S, T, W, Y).

SPIRULINA SUBSALSA Oerst. ex Gom., Ann. Sci. nat. VII Bot. **16**: 253, pl. vii, f. 32 (1892); Collins, RHODORA **2**: 43 (1900); Tilden, Minn. Alg. **1**: 89 (1910); Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913). *S. tenuissima* of Farlow, Mar. Alg. New Engl., 31 (1891); not of Hazen, RHODORA **26**: 215 (1924); not of Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). *S. Thuretii* of Farlow, loc. cit. (1891). *Arthrospira subsalsa* Crow apud Croasdale[19] *pro synon.*, Fresh Water Alg. Woods Hole, Mass., 18 (1935). Authentic material: Farl., Anders. & Eat., Alg. Am. Bor. Exs. 178 (F, Y); LeJolis, Alg. mar. Cherbourg 199 (F); Kütz. Dec. 14: 131 (T).—Often forming blue-green coatings on the bottom in shallow, quiet salt (rarely in brackish) water; more often mixed with other algae in salt marshes, on pilings of wharves, etc. Both f. GENUINA Gom. and f. OCEANICA (Crouan) Gom., ibid. 254, are distinguishable in the collections. Specimens seen: FALMOUTH: on algae attached near garbage wharf, Eel Pond, Woods Hole, *C.-C. Jao*, 20 July 1931 (D, S, W, Y); Woods Hole, *I. Holden*, 15 Aug. 1894 (F); Eel Pond, Woods Holl, *W. G. Farlow*,

[18] Miss Lois Lillick has obligingly allowed me to examine a slide of the original (TYPE) material of this species. Measurements of a considerable number of trichomes show that this material falls well within the dimensional range given by Gomont for the trichomes of *S. major*. I am unable to detect any morphological difference between the trichomes in this material of *S. densa* and those of the authentic material of *S. major* cited here. Another ISOTYPE of *S. densa* has been examined in the Herb. New York Bot. Gard.: INDIANA: floating in Lake St. Mary, Notre Dame University campus, Notre Dame, *J. H. Hoskins 606*, Aug. 1928.

[19] By a liberal interpretation of the present International Rules, we may accept this as the valid publication of the binomial *Arthrospira subsalsa*, even though not designated specifically as a new combination. Taxonomists may well be startled at the naive presentation of a classification of the species of Spirulina by Crow in Trans. Amer. Microsc. Soc. **46**: 142ff (1927).

Sept. 1881 (F); on dead algae in five feet of water, Wood's Holl, *W. G. Farlow*, Aug. 1876 (F); Eel Pond, Woods Hole, *Anon.*, 30 July 1908 (F); in water squeezed from Vaucheria Thuretii, Woods Hole, *W. T[release]*, 15 Sept. 1881 (F); Wood's Holl, Aug. 1876 (Y). GOSNOLD: Gosnold Pond, Cuttyhunk Island, *Anon.*, 28 July 1927 (W). OAK BLUFFS: in shallow water, Squash Meadow Pond, *G. Velasquez & Drouet 1896*, 21 July 1936 (D, F, T).

OSBORN BOTANICAL LABORATORY OF YALE UNIVERSITY AND
DEPARTMENT OF BOTANY, MARINE BIOLOGICAL LABORATORY

EXPLANATION OF FIGURES

FIG. 1. *Schizothrix arenaria*, upper portion of filament from *Drouet 1217*. FIG. 2. *Hydrocoleum glutinosum*, from *Drouet 1917*, showing the apex of a single trichome with sheath. FIG. 3. *Hydrocoleum Holdenii*, the upper portion of a trichome with sheath drawn from the type specimen in the Farlow Herbarium. FIG. 4. *Lyngbya infixa*, an entire filament from *Drouet 1132*. FIG. 5. *Lyngbya Lagerheimii*, from *Drouet 1860*, the upper portion of a filament. FIG. 6. *Phormidium persicinum*, portion of a single trichome from Phyc. Bor.-Amer. 1401 (W). FIG. 7. *Phormidium molle*, portion of a single trichome from a specimen collected by F. S. Collins at Bourne. FIG. 8 AND 9. *Oscillatoria chlorina*, upper portions of two trichomes from West Falmouth, collected by E. T. Rose.—All these figures have a magnification of × 800 and, with the exception of Fig. 3, 6, and 7, are drawn from living material.

NOTES ON THE FLORA OF NOVA SCOTIA

A. E. ROLAND

IN early September 1936, I spent several days upon Long Island, Digby County. Time was taken to visit the Bay of Fundy seashore; and a number of plants were collected along the low banks of a sheltered cove. A *Cornus*, new to me, covered the exposed sides of the banks. I am indebted to Frère Marie Victorin of the University of Montreal for identifying it for me as *Cornus canadensis*, var. *intermedia*.

The following morning, barely enough time was spent upon Brier Island to cross it and return. At the further side by the lighthouse is a meadow many acres in extent, and protected from the waves of the Bay of Fundy only by a low line of rocky ledges. Ten minutes only were spent upon this meadow or bog; but they were sufficient to collect a number of sheets of *Schizaea*, which was found wherever it was looked for; and to secure some individuals of the *Lophiola* which was growing scattered over the area.

The following are some of the plants collected in this region; and